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Study for the high-density matter at J-PARC Heavy-Ion Project

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Heavy ion collisions at $\sqrt{s_{NN}}$ ~ several GeV seem to be the only method to generate ultra-high-density matter comparable to those inside neutron stars experimentally.
In such ultra-high-density matter, many phenomena are expected, such as the transition to the non-confined phase. Among those, a few things are well understood about high-density matter, both theoretically and experimentally, and these are currently being actively studied.

J-PARC Heavy Ion Project (J-PARC-HI) is an experimental project to generate and study ultra-high-density matter using 1-12A GeV heavy ion beams. Although the current J-PARC is a 30GeV proton accelerator, it has successfully supplied a high-intensity beam of about 60kW even in slow extraction. Therefore, the J-PARC-HI case will expect high-flux beams with excellent performance. In other words, only the injector must be newly constructed, and the acceleration afterwards will use the current acceleration scheme as much as possible. The design of the injector and the acceleration scheme is being studied in detail by the J-PARC accelerator group.

We have the staging plan of the project into two stages. In the first stage, a booster ring will reuse the KEK-PS. Even in this stage, we expect to achieve an intensity of 10^8Hz. In the second stage, a new booster ring will be constructed where the highest intensity heavy ion beam of 10^{11}Hz is expected. We consider the primary goal of the first stage as the confirmation of non-confined phases in high-density regions. The purpose of the second stage is to be precise measurements of the high-density matter. Applications such as producing various hyper-nuclei and studying the internal structure of hadrons are also conceivable. In this talk, we would like to discuss these rich physics opportunities and the concept of detector design.

Category

Experiment

Collaboration (if applicable)

J-PARC-HI

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